PHOTOGRAPHIC SILVER HALIDE MATERIAL COMPRISING GOLD COMPOUND

This is a divisional of application Ser. No. 614,536, filed Nov. 16, 1990, now U.S. Pat. No. 5,049,485.

This invention relates to new gold(I) compounds comprising mesoionic ligands and to photographic silver halide materials chemically sensitized with such gold(I) compounds.

Photographic silver halide materials are often chemically sensitized with one or more compounds containing labile atoms of gold, sulfur or selenium and the like to provide increased sensitivity to light and other sensitometric properties. Examples of typical chemically sensitized photographic silver halide emulsions are described in, for example, Research Disclosure, Item No. 308119, December 1989, Section III, and the references listed therein (Research Disclosure is published by Kenneth Mason Publications Ltd., Dudley Annex, 12a North Street, Emsworth, Hampshire PO 10 7DQ, England.)

Gold compounds may contain gold in the (I) or (III) oxidation state. However, those in the (I) oxidation state are preferred because those gold compounds in the (III) oxidation state may undergo side reactions that, for example, oxidize gelatin or other components in photographic emulsions. Among gold(I) compounds, trisodium aurous dithiosulfate is commonly known as a chemical sensitizer, but is not universally applicable because of the disadvantages this compound provides. In particular, this gold(I) compound contains two thiosulfate ions that are bonded to gold. These ions may also undergo sensitization reactions in addition to the gold in a photographic silver halide emulsion. Therefore, this gold(I) compound is not appropriate in silver halide compositions in which an amount of sulfur less than a 2:1 molar ratio with gold is desired in for chemical sensitization, and not appropriate in silver halide compositions in which sulfur or selenium sensitizers other than thiosulfate are desired, such as a silver halide composition as described containing thioureas in U.S. Pat. No. 4,810,626 of Burgmaier et al.

Gold(I) compounds are known that do not contain thiosulfate ligands or other ligands possessing labile sulfur. However, many such gold(I) compounds are not useful as chemical sensitizers for photographic silver halide materials because their dissociation constants are too high and provide low stability. Such gold(I) compounds are susceptible to disproportionation or reduction by gelatin components, especially those in photographic silver halide emulsions. Many gold(I) compounds are not sufficiently soluble to be easily dispersed in a photographic silver halide composition in a uniform and controllable manner.

One gold(I) compound that has been proposed is a gold(I) thiolate as described in U.S. Pat. No. 3,503,749 of Tavernier et al. This compound contains a sulfonic acid sodium salt substituent on the thiolate ligand to impart water solubility. However, the process for preparing such gold(I) compounds involves use of gold fulminate that is dangerously explosive and thus not desirable for practical use.

Other gold(I) compounds, such as those containing alkyl or aryl thiolate ligands are also not useful because the alkyl or aryl thiolate may be readily displaced from the gold compound by protons, as described in, for example, G. E. Coates, B. Kowala and J. M. Swan; *Aust. J. Chem.*, 19, 539 (1966).

It has been desirable to provide a new gold(I) compound that enables chemical sensitization of photographic silver halide compositions for increased light sensitivity without undesired side reactions. It has also been desirable to provide such new gold(I) compounds that are sufficiently soluble and stable for use in photographic silver halide compositions and are easy to prepare without involving dangerous intermediates.

It has been found that the described advantages are provided by a photographic silver halide emulsion, preferably a gelatin emulsion, chemically sensitized with a gold(I) compound of the formula:

$$AuL_2^+X^-$$

or

$$AuL(L^1)^+X^-$$

wherein

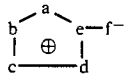
L is a mesoionic compound;

X is an anion; and

L^1 is a Lewis donor ligand.

The compounds may be soluble in any of a variety of solvents, including water or organic solvents such as acetone or methanol, but the most preferred compounds are water soluble. The term water soluble herein means that the gold(I) compound dissolves in water at the concentration of at least 10^{-5} mole per liter of water at a temperature of 20° C. at normal pressure.

The mesoionic compound L herein is any such compound that can be coordinated with gold(I) ions to form a gold(I) compound that is water soluble and enables the described chemical sensitization of a photographic silver halide composition. The mesoionic compound is preferably represented by the formula:



wherein the circle with the + sign on the heterocyclic ring symbolizes six delocalized π electrons associated with a partial positive charge on the heterocyclic ring. The a, b, c, d, and e represent the unsubstituted or substituted atoms necessary to complete the mesoionic compound, for example the carbon and nitrogen atoms necessary to complete a mesoionic triazolium or tetrazolium 5-member heterocyclic ring. The members of the heterocyclic ring (a, b, c, d, and e) may be CR or NR′ groups or chalcogen atoms. The minus sign indicates two additional electrons on the exocyclic group f which are conjugated with the six π electrons on the heterocyclic ring. It is understood that there is extensive delocalization and that the charges indicated are only partial charges. The exocyclic group f may be S, Se, or NR″. The groups R, R′ and R″ may be hydrogen atoms, substituted or unsubstituted alkyl, aryl, or heterocyclic groups, or R, R′ and R″ may link together by bonding to form another ring. (Note: Structural representations for mesoionic compounds L which are different from that given above appear elsewhere in the literature, but here the conventions followed are those described by Ollis and Ramsden in *Advances in Heterocyclic Chemistry*, Vol. 19, Academic Press, London (1976). It is through the exocyclic group f that the mesoionic